

RAPID TRANSIT.

REVIEW

OF THE

REPORT OF THE COMMITTEE

OF

The American Society of Civil Engineers

ON

RAPID TRANSIT.

BY

RICHARD P. MORGAN, JR., C. E.

AND

LETTER OF JULIUS W. ADAMS, C. E.

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## RAPID TRANSIT.

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### REVIEW OF REPORT OF COMMITTEE.

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ST. NICHOLAS HOTEL, }  
New York, Feb. 27, 1875. }

JULIUS W. ADAMS, Esq.,

*President of the American Society of Civil  
Engineers.*

SIR:—I have examined a copy of the report of Messrs. O. Chanute, M. N. Forney, Asbel Welch, Chas. K. Graham, and F. Collingwood, a committee appointed by your Society on the 3d of September last, to consider and recommend plans for the best means of rapid transit for passengers, etc., in the City of New York—which report was read to the Society on the 3d day of February, inst., and given to the public through the press on the 18th inst.\*

\*Gen. J. G. Barnard, one of the original Committee, early informed me that he only acted on the Committee at some of the sittings when plans were being received, and should not participate in the preparation of the report.

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Although I am not a member of your Society, yet, inasmuch as in compliance with its invitation by circular, issued on the 15th day of September, 1874, I had the honor to submit a communication on the subject of rapid transit for passengers in the City of New York, together with detailed plans of the structure which I propose, and diagrams with full calculations of strains, etc., accompanied with estimates of cost, and certain general suggestions relating to the comparative value of the various methods heretofore offered for the solution of the problem of rapid transit of persons; I therefore take the liberty of submitting certain views in regard to the report of your Committee, which seem to me worthy of consideration by the Society.

One inducement to act upon the invitation of the Society, was the suggestion in its resolutions and circular, that the best general plan of rapid transit for passengers, would be recommended by the Committee, and that due credit was to be given to all those who might in their communications present plans and make valuable suggestions.

Believing as I did, and still do, that the Society in its final action would endeavor to do justice, and a public service, and would recommend for adoption what seemed the best plan presented, I unhesitatingly offered my plans and communication for its consideration. The office of the Committee, as I understand it, was *quasi* judicial—to receive and consider the various plans which might be proposed, and to recommend that from among them, which seemed best adapted to secure the result desired.

The general conclusions of the Committee in

regard to the comparative merits of the three classes of roads brought forward—designated as the Underground, Depressed, and Elevated railroad systems—meet my fullest concurrence.

My professional attention was especially directed to this subject by the report of the N. Y. Senate Special Commission in January, 1867.

In considering the question, I early came to the conclusion that the proposed plans for Underground or Depressed (through the blocks) roads, were impracticable; and in a report published by myself in 1869, a copy of which was presented to your Committee with my communication, stated my reasons for that conclusion. The report of your Committee concurs with the views which I then expressed as to the objections to those two methods of construction, and has to a considerable extent adopted the language which I then employed.

Further reflection has confirmed my belief in the correctness of the opinions which I then entertained, as to the comparative merits of the three systems proposed, and I am happy to find that those views have been indorsed by your Committee, both as regards the structure, the power, and rolling-stock proposed, as well as the method of operating the same.

Having reached this result, it only remained to consider whether any plan for an elevated road could be devised, which would meet the necessary conditions of the problem; viz., safety, efficiency, economy of construction, and the least practicable interference with existing vested interests; and also as a whole, presenting a system adapted to not only the present, but the great future of New York.

These considerations were the basis of my action in the preparation of plans adapted to the existing streets and avenues, as set forth in my former reports, and recent communication to your society. Those plans having been approved by many of the most distinguished civil engineers of this country, and having met your own cordial endorsement as "entirely filling the conditions," I was led to hope that the problem which had so long occupied public attention had been substantially solved, and that your committee would so "recommend," and give me "due credit."

In their report the Committee state, on page 18, that upon the avenues "there are two possible locations for an elevated road; either the tracks may be close together over the centre of the roadway, or they may be independent tracks, one on each side of the street." They also observe in regard to the avenues, that in them is found the great obstacle to cheap rapid transit, because "their great width, 60 feet between curbs, adds enormously to the cost of constructing a road over the center of the street, *if support must be taken at the curb stone.*" But if roads shall be constructed upon that plan, the Committee say, that the best seems to be that which I have had the honor to present.

My estimate of the cost of a road adapted to the transportation of passengers only, as carefully revised to suit the present prices of iron and labor, is \$486,000 per mile of double track road. This includes the cost of foundations, stations at half mile distances on each side, and all other expenses except the right of way and rolling stock. The right

of way, on the lines of streets, it is anticipated, inasmuch as it already belongs to the public, will cost nothing. To this there may be an occasional exception in crossing from the line of one street to another, through blocks. The earlier estimate of cost for a passenger road, submitted by me, of \$520,000 per mile, was made at a time before the present low prices of iron and labor.

Though it is not distinctly stated in the report of the Committee, yet I find, greatly to my surprise, that the plan of supporting a double track railway over the centre of the carriage-way, by placing the supporting columns in the road-way of the street, between the curbs, seems to be favored by them. They say in their report, page 20, that "The argument in favor of placing posts in the road-way to carry an elevated road over the centre of an avenue is the single one of economy; as it will cost twice as much, if the support is taken from the edge of the curb, as it will if the posts are placed in the carriage-way." Again, on page 28, they say, "A requirement that the tracks should be over the centre of the street, and bearing be taken from the edge of the side-walk would more than double the expense."

In these statements of comparative expense, the Committee are greatly mistaken. The cost of equivalent roads with equal length of spans along the streets or avenues, may be divided into four parts —three of which are substantially constant, and one only, is variable.

The cost of the foundations which carry the superstructure, at distances suggested by the Committee,

50 feet, page 20, would be practically the same in either case whether constructed near the centre of the carriage-way or at the curb-stone.

In passing it may, however, be remarked, that the interference with the use of the street while constructing foundations in the carriage-way near its centre, will be very much greater than if they are at the sidewalk, and that the risk of injury to sewers, gas and water mains, by excavations in the middle of the street will be considerable, and will not exist by excavations at the sidewalks.

Likewise the longitudinal trusses and structure to carry the tracks would cost the same. The stations, approaches and platforms, are exactly alike in cost, when equal in number and capacity. This leaves the fourth element only, variable as above suggested, viz.: the transverse frame which supports the railway:—and the difference in cost stated by the Committee must be found in this element.

The Committee referring to a road supported on posts in the carriageway say on page 21, that "a double track road can be built for \$300,000 per mile on an assumed rolling load of 1,200 lbs. per lineal foot of track, exclusive of stations or equipment." As no data are given in their report from which this result is reached, I am unable to test its correctness by any direct calculation. It is sufficient however, to say that after deducting from their assumed cost, the cost of foundations, roadway, and longitudinal trusses, as estimated in my communication, it leaves almost no residuum to cover the cost of the transverse frames which support the track and longitudinal structure. Whatever difference

therefore, may exist in the whole cost of the structures, must be found in the different cost of the transverse frames. Referring as a comparison to my estimate of the cost of a road competent to sustain a rolling load of 2,000 lbs. per lineal foot on each track, appended to my communication, it will be seen, that the cost of the transverse frames in one section, 75 feet, is \$3,960 each, while the total cost of the span, including foundations, longitudinal work, proportion of stations and entrance-ways, engineering and contingencies, is \$11,947.76. The cost therefore, of the transverse frames, is a very little less than one-third of the total cost of the road.

The difference in the cost of the transverse frames constructed upon the plan which I propose to span a street of 50 feet carriage way, or one of 60 feet, instead of being "enormous," as the Committee state, even when applied to the frames themselves, and not to the total cost of the road, is but slight. I have already shown that the difference in widths of streets has no appreciable effect upon the cost of any portion of equivalent elevated roads, except the transverse supports to the longitudinal work. If the frames constructed on my plan shall be widened so as to span a 60 feet carriage way, instead of one narrower, say 46 feet, the necessary change will be only the lengthening and slightly increased strength of the interior connections between the supporting ribs; and the difference in cost, therefore, cannot but be slight. Whatever the width of the street may be, the cost of all but the transverse frames remains unchanged; and, therefore, the statements of the Committee, p. 18, that the additional width of the street

"adds enormously to the cost of constructing a road," or that, p. 20, "it will cost twice as much if the support is taken from the edge of the curb as it will if the posts are placed in the carriage way," or that, p. 28, "a requirement that the tracks should be over the centre of the street, and bearing be taken from the edge of the sidewalk, would more than double the expense," are extravagant, and entirely unwarranted by the truth.

But it is evident from what has just been said that the difference in the cost of these transverse frames cannot be so great as to reconcile the discrepancy between the estimate of the Committee and my own, as to the total cost of the road, nor justify their extravagant language page 18, that the width of the avenues "adds enormously to the cost of constructing a road over the centre of the street if support must be taken at the curbstone."

In view of the foregoing facts, and having several years since made approximate estimates of the cost of the plan suggested by your Committee, I am convinced that they have greatly exaggerated the difference between the cost of the plans under consideration.

I desire to call your attention to a surprising inconsistency, contained in the report of your Committee, when comparing the probable pecuniary value of a road constructed upon my plan, and the value of a road constructed upon any plan. On page 19 of their report the Committee say, in reference to my plan costing \$486,000 per mile, "if the estimates of revenue and operating expenses made by your Committee are correct, there is but one line which

can afford to adopt such a plan ;" and yet, on p. 33, in summing up the result of their estimated sources of revenue, and all the plans and schemes submitted to them—75 in all—the Committee says it has reached five conclusions, the first of which is in these words :

" 1st. In order to be profitable with the fares and volume of business likely to be obtained, double tracked rapid transit roads should not be planned to cost, fully equipped, much, if any, more than from \$700,000 to \$1,125,000 per mile, according to location ; and this points to some form of elevated railroad as the leading feature of the design to be recommended."

Why it is that a line of road which is to cost \$486,000 per mile, can be profitable only upon "one route" in this city, when the Committee state as a general result of their investigations, that roads costing from \$700,000 to \$1,125,000 per mile may be expected to be profitable, I leave to them to explain. True, in the former estimate the cost of equipment is not included ; but the Committee estimate the cost of stations and equipment for the greatest business contemplated by them, viz., 35,000,-000 passengers annually, at \$225,000 per mile. In my estimate stations are included at \$40,000 per mile, leaving, therefore, to be added to \$486,000, \$185,-000 per mile for equipment, making the aggregate cost of the road, stations and equipment, \$671,000 per mile, or less than the minimum cost estimated by the Committee for a profitable line. I ask again, how can the Committee justify themselves in

saying that "there is but one line which can afford to adopt such a plan."

The Committee having reached the conclusion that the only practicable plan for rapid transit, p. 33, "points to some form of elevated railroad as the leading feature of the design to be recommended," seem to indicate that the road should be supported by posts placed near the middle of the carriage-way of the street. They have assumed that a road so constructed would be much more economical than any other, costing less than half, etc., pp. 20, 28. The great inaccuracy of this assumption appears by what has already been said.

The objections to the support of an elevated road by placing posts in the carriage-way of the streets, I have considered on pp. 14, 15 and 16 of my original communication, to which I respectfully refer you, without repeating what I then said. These objections are somewhat reduced by the suggestion of your Committee, p. 20 of their report, that the supports should be placed at intervals of about 50 feet instead of 16 feet as originally proposed. The greater distance between the supports, however, increases the cost of the structure by the additional strength required in the supports themselves, and especially in the longitudinal part of the road. The suggestion of the Committee on p. 21, that a police regulation requiring that vehicles proceeding rapidly should hug the line of the posts, and that those proceeding slowly, should hug the side-walk, recognizes the difficulty which such a structure would occasion in the ordinary use of the street. Without intending

any disrespect to the Committee, I may be permitted to express my doubt, whether a police regulation which seeks to divide the street traffic of a great city into two parts, one like a funeral procession going slowly to the cemetery, and the other hastening on its return, can be enforced, or would prove in the slightest degree useful.

Whatever plan may be adopted for rapid transit, must be one looking to the future, as well as to the present; and the structure should be one which will be permanent.

I do not believe that the suggestion of the Committee on p. 20 of the report, that in portions of streets where "the traffic is now, and is likely to continue so small, and the adjoining buildings are of so poor a character, that if the spans be made about 50 feet, posts within the roadway are not likely to prove a serious annoyance," is well founded. If the traffic is as small as indicated, no rapid transit road is required, unless it is likely to increase when rapid communication is provided. In that case, the structure should, in the first instance, be such as to encourage and facilitate the expected increase.

The Committee seem to act upon the supposition that those avenues where the surface traffic, p. 20, "is so large, or the property so valuable, that support must be taken at the sidewalk," are the only ones to which that condition will ever apply. The very object of constructing lines of rapid transit to the upper part of the city, is to furnish facilities for its occupation, and to concentrate there a dense population, requiring streets as free from obstruction, as those which

the Committee state have so large a surface traffic, that support for an elevated road must be taken from the sidewalk.

The design therefore which shall be adopted should meet that necessity, and should not be one temporary in its character; to be changed only after a long interference with public convenience. It seems clear that a due regard for the future of New York, would forbid the adoption of the suggested plan of your Committee.

The confidence which I expressed in my original communication, in the ability and desire of your society to determine justly upon the various plans proposed for rapid transit in New York, and which I still entertain, has induced me to present to you this review of the report of your Committee. I have confined myself in what has been said, to a review of so much of that report as relates to the transit of persons by a system of elevated roads constructed along the lines of existing streets.

Some of the inconsistencies of that report, and the grave errors into which the Committee have fallen, it has been attempted to show from the language of the report itself, as before quoted. That such errors exist seems evident, and that the report of the Committee does serious injustice to the plan of road proposed by myself, and fails to fulfill public expectation as to the effect of the action of your Society on this great subject, is certain. Whether your Society will deem it wise to pursue the topic further, and announce its views as to the best plan of roads for rapid transit in cities, and so furnish the guide

to public action, which the position of the Society justifies, and which has been so generally expected, it alone can determine.

Very respectfully, etc.,

RICHARD P. MORGAN, JR.,

*Civil Engineer.*

BROOKLYN, N. Y., March 1, 1875.

RICHARD P. MORGAN, JR., Esq.,

DEAR SIR,—Your favor of the 27th inst., commenting upon the report of the Committee on rapid transit, etc., of the American Society of Civil Engineers is received.

I will communicate the same to the Society, as you request.

I have examined it with interest, and concur with the conclusions which you state. As I wrote to you before, your plan seemed to me, when I examined it, to fulfill the conditions required to furnish rapid transit in great cities. I am still firm in that opinion, and fully believe that your structure, with occasional modifications as you have indicated, to meet exceptional conditions, is the best which has been presented.

Its stability, efficiency, economy, tasteful form and facility of construction, all unite to recommend it to public favor; and in these respects combined, it possesses merits which no other plan yet suggested does, and which, I doubt not, will in practice, if it shall be constructed, satisfy fully all the expectations of its friends and the public.

You are at liberty to make such use of this letter as you may see fit.

Very respectfully, etc.,

JULIUS W. ADAMS,

*Civil Engineer.*



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